PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : H04N 1/32 — A2

(11) International Publication Number: WO 98/20672

(43) International Publication Date: 14 May 1998 (14.05.98)

(21) International Application Number: PCT/US97/20309

(22) International Filing Date: 6 November 1997 (06.11.97)

(30) Priority Data:

8/296830	8 November 1996 (08.11.96)	JP
9/282468	9 September 1997 (09.09.97)	JP

(71) Applicant *(for all designated States except US)*: MONOLITH CO., LTD. [JP/JP]; 1–7–3, Azabu–juban, Minato–ku, Tokyo 106 (JP).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: ITO, Hirofumi [JP/US]; 11500 San Vicente #217, Los Angeles, CA 90049 (US). YAMASHITA, Shinichi [JP/JP]; Triaxis Corp., Ltd., 693–47–1, Suenaga, Takatsu–ku, Kawasaki–shi, Kanagawa 213 (JP).

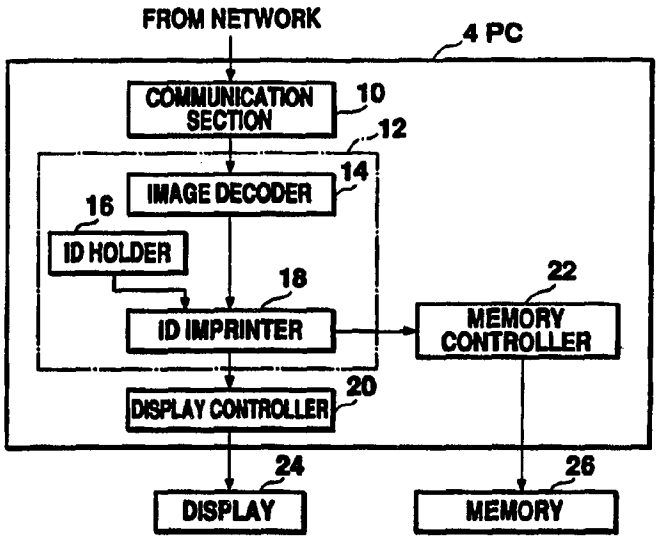
(74) Agents: KANG, Jonathan, Y. et al.; Loeb & Loeb LLP, Suite 2200, 10100 Santa Monica Boulevard, Los Angeles, CA 90067 (US).

(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, EE, ES, FI, GB, GE, GH, HU, ID, IL, IS, JP, KE, KG, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).

Published

Without international search report and to be republished upon receipt of that report.

(54) Title: METHOD AND APPARATUS FOR IMPRINTING ID INFORMATION INTO A DIGITAL CONTENT AND FOR READING OUT THE SAME



(57) Abstract

After a digital content is loaded into an information terminal such as a PC, ID information unique to a viewer or a user of the PC is imprinted into the content. The ID information is imprinted into a predetermined location of the content or alternatively, it may be imprinted over the entire content in the form of a spatial frequency. The content with an ID added thereto is then enabled to be used in the terminal.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	**ES**	Spain	**LS**	Lesotho	**SI**	Slovenia
AM	Armenia	**FI**	Finland	**LT**	Lithuania	**SK**	Slovakia
AT	Austria	**FR**	France	**LU**	Luxembourg	**SN**	Senegal
AU	Australia	**GA**	Gabon	**LV**	Latvia	**SZ**	Swaziland
AZ	Azerbaijan	**GB**	United Kingdom	**MC**	Monaco	**TD**	Chad
BA	Bosnia and Herzegovina	**GE**	Georgia	**MD**	Republic of Moldova	**TG**	Togo
BB	Barbados	**GH**	Ghana	**MG**	Madagascar	**TJ**	Tajikistan
BE	Belgium	**GN**	Guinea	**MK**	The former Yugoslav Republic of Macedonia	**TM**	Turkmenistan
BF	Burkina Faso	**GR**	Greece			**TR**	Turkey
BG	Bulgaria	**HU**	Hungary	**ML**	Mali	**TT**	Trinidad and Tobago
BJ	Benin	**IE**	Ireland	**MN**	Mongolia	**UA**	Ukraine
BR	Brazil	**IL**	Israel	**MR**	Mauritania	**UG**	Uganda
BY	Belarus	**IS**	Iceland	**MW**	Malawi	**US**	United States of America
CA	Canada	**IT**	Italy	**MX**	Mexico	**UZ**	Uzbekistan
CF	Central African Republic	**JP**	Japan	**NE**	Niger	**VN**	Viet Nam
CG	Congo	**KE**	Kenya	**NL**	Netherlands	**YU**	Yugoslavia
CH	Switzerland	**KG**	Kyrgyzstan	**NO**	Norway	**ZW**	Zimbabwe
CI	Côte d'Ivoire	**KP**	Democratic People's Republic of Korea	**NZ**	New Zealand		
CM	Cameroon			**PL**	Poland		
CN	China	**KR**	Republic of Korea	**PT**	Portugal		
CU	Cuba	**KZ**	Kazakstan	**RO**	Romania		
CZ	Czech Republic	**LC**	Saint Lucia	**RU**	Russian Federation		
DE	Germany	**LI**	Liechtenstein	**SD**	Sudan		
DK	Denmark	**LK**	Sri Lanka	**SE**	Sweden		
EE	Estonia	**LR**	Liberia	**SG**	Singapore		

METHOD AND APPARATUS FOR IMPRINTING ID INFORMATION INTO A DIGITAL CONTENT AND FOR READING OUT THE SAME

This invention relates to a method for imprinting identification information (ID) into a digital content and for reading that information.

BACKGROUND

The information superhighway was advocated in the United States in 1991, and since then distribution of information over networks as represented by the Internet has been forming a new society base. In this new network society, secure encryption and authentication are desired in such fields as electronic commerce because such fields are concerned with safety.

On the other hand, one of the principles of the Internet is the free distribution of digital contents such as pictures, animation and music (hereinafter collectively referred to as contents). Presently, even for valuable content, such as cultural works, illegal copies can be easily made and distributed. Collecting fees for using contents on the Internet, preventing illegal reproduction or modification, and protecting copyrights are serious problems that need to be addressed and solved. These issues are extremely important for the mutual development of a network society and culture.

It is therefore desired to design a general approach to trace illegal copies of digital contents.

SUMMARY

It is the object of this invention to provide an identification (ID) imprinting method applicable to existing contents.

It is a further object of this invention to provide an ID imprinting method applicable to a content having no reserved areas or areas for remarks that do not play any role in the content.

It is still another object of this invention to provide an ID imprinting method which does not introduce substantial degradation of the content quality when an ID information is imprinted.

It is yet another object of this invention to provide an ID imprinting method for embedding an ID information that can be easily detected.

It is yet another object of this invention to provide an ID readout method to easily detect and interpret the ID information imprinted in the content.

A method according to an embodiment of the present invention comprises loading a content into an information terminal where the content is used and imprinting an ID information associated to the information terminal or its user into a predetermined location in a perceivable portion of the loaded content. (A content may be any collection of digital data, and may be in the form of a sequence of data values. A perceivable portion contains data that play a role in the content, rather than reserved areas or areas for remarks that do not play any role in the content.)

The content is first loaded into an information terminal. Subsequently, an ID information is imprinted into a predetermined location of the content. A user who reproduces illegal copies of the content is identified with the ID information imprinted therein. Since the ID information is imprinted in a predetermined location, no string search is necessary. This method is applicable to existing contents, since it requires no special data blocks beforehand.

In another aspect of the invention, an ID information is imprinted in the form of spatial frequency information into the entire content loaded into an information terminal. "Spatial frequency information" is information relative to a spatial frequency in any sense. In this aspect, the ID information is converted into spatial frequency information via, for instance, an inverse orthogonal transformation so as to be reflected in the content data. The inverse orthogonal transformation may be an inverse fast Fourier transform (IFFT) or an inverse discrete cosine transform (IDCT). This method is also applicable to existing contents.

According to the ID reading process of this invention, a content is first obtained for instance via a network, and an ID information is read from a predetermined location thereof. The ID information is uniquely associated with an information terminal or its user. In another aspect, spatial frequency information is extracted from the obtained content, and then supplied for an orthogonal transformation. Through the transformation, the ID information imprinted in the content is restored. An orthogonal transformation may be a fast Fourier transform (FFT), a discrete cosine transform (DCT), and so forth.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and the other objects, features, and advantages, will become further apparent from the following description of the preferred embodiment taken in conjunction with the accompanying drawings wherein:

Fig. 1 is a diagram showing a network system to which a preferred embodiment of

the present invention is applied;

Fig. 2 is a flowchart showing an operation for ID imprinting when a PC 4 receives a content;

Fig. 3 is a diagram showing a structure relative to ID imprinting within the PC 4;

Fig. 4 is a diagram showing the internal structure of an ID imprinter 18 from Fig. 3;

Fig. 5 is a diagram showing another structure of the ID imprinter 18 shown in Fig. 3;

Fig. 6 is a diagram showing the relationship between ID and a spatial frequency, expressed using a spectrum domain;

Fig. 7 is a diagram showing ID of a user converted into an actual image data pattern by IFFT section 40 in Fig. 5;

Fig. 8 is a diagram explaining a method for imprinting a bit pattern shown in Fig. 7 onto a decoded image;

Fig. 9 is a diagram showing a spectrum domain of Fig. 6 including fixed reference information superimposed therein;

Fig. 10 is a flowchart showing an operation of a detection device for reading ID imprinted in the content;

Fig. 11 is a diagram showing a structure of ID reader within a detection device;

Fig. 12 is a diagram showing another structure of the ID reader shown in Fig. 11;

Fig. 13 is a diagram showing an area consisting of 3x3 pixels;

Fig. 14 is a diagram showing the luminance of the 3x3 pixel area of Fig. 13 expressed using modulo 3 arithmetic;

Fig. 15 is a diagram showing a data pattern to be imprinted as ID into the 3x3 pixel area of Fig. 13; and

Fig. 16 is a diagram showing the state in which either an offset 0 or ±1 is added to the luminance of respective pixels to change the state shown in Fig. 14 into that shown in Fig. 15.

DETAILED DESCRIPTION OF THE EMBODIMENTS

The present invention may be applied to a network system comprising a server 2 and client devices connected on a network 9, as shown in Fig. 1. In this drawing, client devices include PCs 4 and 8 and a Personal Digital Assistance (PDA) 6, which are information terminals.

The server 2 supplies a content to the client devices so that ID imprinting is carried out on the client side. Here, as an example, the PC 4 is provided with an imprinting function.

Fig. 2 is an operational flowchart of the PC 4 when it receives a content. The PC 4 first downloads the content from the server 2 over the network 9 (S0). A program for decoding or decrypting the content is also downloaded from the server. This program may be included in a downloaded viewer or browser that turns the encrypted content into a usable form. A user ID information associated with the PC 4 or its user is embedded in the viewer. The ID is imprinted in the content when the viewer decodes the content (S2). After the ID is imprinted, use of the content such as for displaying or copying is enabled.

Fig. 3 shows the structure relating to ID imprinting within the PC 4. In the following example, the content is assumed to be an image. The user first sends a request for a content to a content manager or supplier (not shown) which runs the server 2. The content manager, after authentication of the user, transmits the requested content and a viewer 12 to the PC 4 via the network. These are received by a communication section 10 of the PC 4.

The viewer 12 received in the PC 4 may now be used to decrypt and display the received content. As shown in Fig. 3, the content is inputted to the viewer 12. The viewer 12 comprises an image decoder 14 for decoding an image which has been compressed or encoded by the content manager before transmission to the PC 4, an ID holder 16 for storing IDs, and an ID imprinter 18 for imprinting the ID read from the ID holder 16 onto a decoded image. The image decoder 14 has a decryption algorithm. The content manager transmits the viewer 12 after storing an ID unique to the user requesting the content in the ID holder 16. The viewer 12 may be a plug-in type device that is incorporated into existing Internet browsers.

As a measure for preventing use of content before ID imprinting, for instance, a memory area in the PC 4 that stores a content without an ID imprinted therein is protected by the ID imprinter 18 so that reading of such a content is prevented. Specifically, the system is designed so as to be interrupted or reset if a read access is made to the memory area containing a content without an ID. Once an ID is imprinted, this protection is removed, enabling the image to be used as desired.

As shown in Fig. 3, an image having an ID imprinted therein is transmitted to a display controller 20, where it is converted into display format for a display 24. A memory controller 22 writes data to a storage device 26, which may be a hard disc unit or the like, to store the decoded image therein.

Fig. 4 is a diagram showing an internal structure of the ID imprinter 18 shown in Fig. 3 according to one embodiment of the present invention. The imprinter 18 comprises an ID

reader 30 for reading an ID from the ID holder 16, a decoded image reader 32 for reading a decoded image, and a combiner 34 for imprinting an ID into a predetermined location such as the leading, middle, or trailing part of the decoded image data. When an ID consists of n bits of data and the luminance of image pixels in the content is expressed in multiscale, the combiner 34 for instance sequentially replaces the least significant bits (LSBs) of the luminance of n pixels from the leading part of the image by the n bits of ID data.

In operation, the user of the PC 4 requests the server 2 run by the content manager to transmit a content. The content is encrypted on the server 2 and then sent with the viewer 12 to the PC 4 via a network. The communication section 10 of the PC 4 receives the transmitted content, and forwards it to the viewer 12, which has been received from the network. Within the viewer 12, the image decoder 14 decodes the content, and forwards it to the ID imprinter 18. The ID reader 30 in the ID imprinter 18 reads the ID from the ID holder 16 and supplies it to the combiner 34. The decoded image reader 32 reads the decoded image, and forwards it to the combiner 34. Having received the ID and the decoded image, the combiner 34 replaces the LSBs of the luminance in the aforementioned manner to thereby imprint the ID onto the image. The image having the ID is displayed on the display 24. The ID imprinted image may also be supplied to the memory 26. If a subsequent unauthorized attempt is made to modify or reproduce the ID-imprinted image stored in the memory 26, copies of such modified or reproduced image will carry the ID information imprinted in the image stored in the memory 26. It is therefore possible to identify the party making the unauthorized copies.

Fig.5 is a diagram showing an alternative structure of the ID imprinter 18 according to another embodiment of the present invention. In this figure, the same members as shown in Fig.4 are given the same reference numerals and their explanation is not repeated. The structure in Fig. 5 comprises an IFFT section 40 for performing an inverse fast Fourier transform (IFFT) on a signal representing an ID, and a combiner 42 for combining the transformed ID (i.e. the output of the IFFT section 40) into the decoded image.

In this embodiment, the ID information is represented as a signal in the frequency domain. When imprinting such an ID, an inverse orthogonal transform is applied to the frequency signal representing the ID information to generate a bit pattern in the content domain, which is then imprinted in the digital content. In this specification, the term "content domain" is used to denote the domain representing the data in the digital content, while the term "frequency domain" is used to denote a mapping of the content domain through an orthogonal transform. When the content is a two-dimensional image (an example

used in the illustration below), the content domain is a two-dimensional space domain, and the corresponding frequency domain is a two-dimensional spatial frequency domain. When the content is audio, the content domain may be a time domain and the frequency domain may be a one-dimensional frequency domain.

Fig. 6 is a diagram showing examples of representations of ID information as signals in the frequency domain. A two-dimensional image is used as an example of a content. The rectangle 52 represents a two-dimensional spatial frequency domain for the two-dimensional space domain. The arrows 54a and 54b indicate the x and y directions of the corresponding space domain, whereas the arrows 56a and 56b indicate the directions of increased frequencies in the frequency domain corresponding to the x and y directions of the space domain, respectively. In this frequency domain, signals representing the ID information for three users A, B, and C are plotted at their respective positions (xa, ya), (xb, yb), and (xc, yc). For user A, for example, the frequency signal has a steep peak centered at the point (xa, ya). The steep peak may have finite widths, or it may be a delta-function. In this manner, the ID information for a user is represented by a point in a two-dimensional frequency domain.

Fig. 7 is a diagram showing user A's ID information converted into a bit pattern in the space domain by the IFFT section 40. The pixels in the bit pattern showing in Fig. 7 have a value of "1" in the shaded areas and "0" in the unshaded areas. In this example, since the frequency signal representing user A's ID information is located substantially at the center of the spectrum domain with respect to both the x and y directions (see Fig. 6), the spatial frequencies of the shaded and unshaded areas shown in Fig. 7 are more or less the same in the x and y directions. For user B, for example, since the frequency signal representing that user's ID information has higher frequencies in both directions, the shaded and unshaded areas in the resulting bit pattern will be narrower (not shown).

Fig. 8 is a diagram explaining a method for imprinting a bit pattern containing ID information, such as that shown in Fig. 7, onto the decoded image (the digital content). In this example, luminance values of the pixels of the decoded image are expressed in eight-bit binary data. The ID information is imprinted in the decoded image by replacing the LSB of the luminance value of each pixel by the value of the corresponding pixel in the bit pattern containing the ID information. Thus, in this example, the LSB of a pixel in the decoded image located in an area corresponding to a shaded area in Fig. 7 is replaced by "1", and the LSB of a pixel located in an area corresponding to a unshaded area in Fig. 7 is replaced by "0." The remaining seven bits of the luminance value of the pixel are unchanged from the decoded image. Thus, in this embodiment, an ID is imprinted over the entire image or an

extended portion thereof. This method is advantageous as a countermeasure against partial cut-off of the content, as the extended portion over which the ID is imprinted may be chosen such that the cut off of which would substantially impair the usefulness of the content.

Specific embodiments of the present invention for imprinting ID information have been described. Many variations of the embodiments are possible, some of which are described below.

First, although a content is distributed via a network in the above-described embodiments, the content may also be distributed by storing it in a medium such as a CD-ROM or a floppy disc and loading it onto a PC. The embodiments described above are applicable to such other methods of content distribution.

Second, although a still image is used in the above-described embodiments as an example of a digital content, the methods may be applied to other types of digital content, such as motion images (e.g. video) or audio content. For motion images, ID information may be divided into plural portions and different portions may be imprinted into different image frames. For audio content, the image decoder 14, the display controller 20, and the display 24 in Fig. 3 may be replaced by an audio decoder, an audio output controller, and a speaker, respectively. Further, one-dimensional IFFT is sufficient for audio content, as it is one dimensional data. In addition, although ID information is imprinted into the bits of the luminance values in the case of images, it may be imprinted into the LSBs of frequency signals or the like in the case of an audio content.

Third, an ID is not necessarily stored in the LSBs of a content. Any bits of quantified data may store the ID as long as the effects on the perceived quality of the content are insignificant. It should be noted that even perceptible imprinting may be employed as a visual watermark.

Fourth, although an ID is imprinted into a lower bit irrespective of upper bits in the aforementioned embodiment, an offset may be given to a lower bit such that the whole data including upper bits contains the ID.

Fig. 13 shows an example of a 3x3 pixel area in a content such as an image, where the luminance of the respective pixels are "10, 8, 0...." as shown. Fig. 14 is a diagram showing the luminance of the same 3x3 pixel area in the image, but expressed using modulo 3 arithmetic. Using this arithmetic, the corresponding value of a pixel whose luminance is 10, for instance, becomes 1. Fig. 15 is a diagram showing a sample data pattern representing ID information, generated using methods described earlier, to be imprinted into the 3x3 pixel area of the image shown in Fig. 14. The ID pattern is also expressed in modulo 3 arithmetic.

In this example, 0's, 1's, and 2's are to be imprinted into the first, second, and third rows of pixels, respectively. Fig. 16 is a diagram showing the state in which an offset of -1, 0, or 1 is added to each pixel value of the 3x3 pixel area shown in Fig. 14 to obtain the corresponding pixel value of the 3x3 pixel area shown in Fig. 15. In operation, the ID information is imprinted into the 3x3 pixel area of the image shown in Fig. 13 by adding to each pixel an offset value -1, 0 or 1 according to the calculation shown in Fig. 16. According to this method, an offset is added to the luminance data as a whole, so that the whole data, including the upper bits, contain the ID.

Since this method can prevent direct exposure of an ID unlike imprinting it in the lower bits, security is increased. Another advantage is that data other than "0" and "1", such as "2", is also imprintable. Although modulo 3 arithmetic is mentioned here, modulo arithmetic based on other numbers may be used. Any other mathematical, boolean algebraic or cryptographic approach may be employed.

Fifth, in the aforementioned embodiments, the combiner 34 (Fig. 4) imprints ID information into a predetermined location such as the leading part of the data sequence. The predetermined location may be one where, when slight shifts in data values are given, the effects are hardly perceivable. Thus, the quality of the content (quality of a still image, motion image, sound, text and so forth) is hardly influenced.

Sixth, in the embodiment shown in Fig. 3, the image decoder 14 and the ID imprinter 18 are separately provided. These elements may be integrated into one element to thereby allow simultaneous execution of image restoration and ID imprinting.

Seventh, in the embodiment shown in Fig. 3, the program for decrypting and/or decoding is included in a viewer or a browser. The program may take any other form as long as it can restore the content into a suitable format for use by the user.

Eighth, although the ID information for one user is represented by one point in the frequency domain (Fig. 6), the ID information may be represented in other forms. For instance, a set of a plurality of discrete points or a two dimensional region may be employed to represent the ID information for one user.

Ninth, in a frequency domain representation such as that shown in Fig. 6, reference information such as two straight lines 100, 102 shown in Fig. 9 may be added. This reference information can be utilized when reading the imprinted ID information from a content since its position is fixed and known in the frequency domain. By the help of the reference information, the location of the ID can be specified with more certainty to thereby identify the user represented by that ID even when the content has been modified through,

e.g., rotation or enlargement.

Methods for imprinting ID information have been described. Methods for reading imprinted ID information will be described next.

If a content is illegally reproduced or modified (hereinafter referred to as an illegal action), it is desired that the unauthorized offender be identified. This can be achieved by reading the ID information imprinted into the content. A device for reading imprinted ID information (hereinafter referred to as a detector) may be provided anywhere in a network. A proxy server, for instance, may be equipped with such a detector.

Fig. 10 is a flowchart showing the operation of a detector. The detector loads a content from a storage device or a memory medium (S10), and reads the ID information imprinted therein (S12). If an illegal action is detected, the detector resorts to appropriate measures, such as notifying a content manager of the unauthorized offender.

Fig. 11 is a diagram showing an embodiment of the detector for reading ID information imprinted in a content. The detector 60, which may be in a PC, comprises a communication section 62 for obtaining a content from a network, an ID reader 64 for reading the ID from the obtained content, and a display controller 66 for controlling a display 68 so as to display the read ID.

In this embodiment, the ID reader 64 extracts information from a predetermined location, for instance, the LSBs at a leading part of a data sequence of the obtained content, and reconstructs the ID based on the extracted data. If this process does not result in any ID information that meaningfully identifies a user, then the content is judged to be original, i.e., having no user ID information imprinted. On the other hand, if a content with a user's ID imprinted therein is found on a network, the user identified by the imprinted ID may have illegally distributed the content. Based on the ID, the possible illegal action is traced.

Fig. 12 is a diagram showing an alternative ID reader according to another embodiment of the present invention. This ID reader operates to read an ID imprinted as spatial frequency information in a content. The ID reader 64 comprises an LSB extractor 72 for extracting the LSBs from the obtained content to form a bit pattern, and a FFT section 74 for performing fast Fourier transform (FFT) on the bit pattern formed by the extracted LSBs.

The operation here is a reverse operation of that shown in Figs. 6 to 8. The LSBs, which represent the imprinted ID information, are first extracted (Fig. 8). The bit pattern formed by the LSBs in the content is then detected (Fig. 7). Spatial frequencies of the bit pattern in the x and y directions, respectively, are calculated by the FFT section 74 from the bit pattern. In the sample bit pattern shown in Fig. 7, the FFT calculation reveals user A's ID

shown in Fig. 6. The offender is thereby identified as user A.

This method is advantageous in that it does not require comparing the suspect content and the original content in order to detect the ID.

The above-described methods for reading imprinted ID information may have many variations. Each variation of the ID imprinting method described earlier in this specification may have a corresponding variation of the ID reading method. For example, the ID can be read in cases where an offset has been added to a lower bit using a method such as the one described earlier with reference to Figs. 13-16. Further, when an ID is imprinted in a predetermined location of the content, such as a location where shifts in data values do not produce significant perceivable effects, the readout method is provided to detect the same location consistent with the ID imprinting method. Generally speaking, ID reading can be done as long as the imprinter and the reader adopt the same imprinting/readout scheme.

In addition, although the detector is connected to a network in the above embodiments, it may be an off-line, stand alone type if it checks only contents stored in storage media.

Moreover, in the described embodiments, the ID imprinting is carried out at the information terminals where the content is used, i.e. at the user end. It will be apparent to a skilled artisan, however, that the various methods described herein for imprinting ID information in a content are equally applicable to a content distribution scheme in which ID imprinting is carried out at the content provider end.

It will, of course, be understood that modifications of the present invention, in its various aspects, will be apparent to those skilled in the art. Other embodiments are also possible, their specific designs depending upon the particular application. Therefore, the scope of the invention should not be limited by the particular embodiments herein described but should be defined only by the appended claims.

WHAT IS CLAIMED IS:

1. A method for imprinting identification information (ID) in a digital content comprising data values, the method comprising:

loading the digital content into an information terminal at which the digital content will be used; and

imprinting a representation of an ID associated with the information terminal or the user thereof into a perceivable portion of the loaded content.

2. The method of claim 1 wherein the representation of the ID is imprinted into a predetermined location in the loaded content.

3. The method of claim 2 wherein the imprinting step comprises manipulating a lower bit of the data values at the predetermined location of the loaded content.

4. The method of claim 3 wherein the representation of the ID comprises a plurality of bits, and wherein the manipulating step comprises replacing the least significant bit of each of a sequence of data values at the predetermined location of the loaded content by a corresponding bit in the representation of the ID.

5. The method of claim 2 wherein the imprinting step comprises adding an offset to each of a sequence of data values at the predetermined location of the content.

6. The method of claim 5 wherein the representation of the ID comprises a plurality of digits each having one of N possible values, N being a predetermined integer, and wherein the offset added to each of the data value is dependent upon the remainder of the sum of the data value and the offset divided by N, and upon a corresponding digit in the representation of the ID.

7. The method of claim 2 wherein the predetermined location is a location where imprinting of ID at the location does not produce significant perceivable effects in the digital content.

8. The method of claim 1 wherein the representation of the ID is imprinted into the loaded digital content over an extended portion of the loaded content.

9. The method of claim 8 wherein the extended portion of the loaded content defines a content domain, and wherein the representation of the ID is a representation in a frequency domain associated with the content domain.

10. The method of claim 9 wherein the frequency domain is a mapping of the content domain via an orthogonal transform, and wherein the step of imprinting comprises:

inverse-transforming the frequency-domain representation of the ID into a content-domain representation of the ID via an inverse of the orthogonal transform; and

imprinting the inverse-transformed ID into the content.

11. The method of claim 10 wherein the imprinting step comprises manipulating a lower bit of data of the content.

12. The method of claim 11 wherein the inverse-transformed ID comprises a plurality of bits, and wherein the manipulating step comprises replacing the least significant bit of each of a plurality of data values of the content by a corresponding bit in the inverse-transformed ID.

13. The method of claim 10 wherein the imprinting step comprises adding an offset to each of a plurality of data values of the content.

14. The method of claim 13 wherein the inverse-transformed ID comprises a plurality of digits each having one of N possible values, N being a predetermined integer, and wherein the offset added to each data value is dependent upon the remainder of the sum of the data value and the offset divided by N, and upon a corresponding digit in the inverse-transformed ID.

15. The method as defined in claim 8 wherein reference information is imprinted into the digital content in the form of reference information in the frequency domain.

16. The method of claim 1 wherein the loaded content is encrypted, and wherein the imprinting step comprises:

decrypting the loaded content; and

imprinting a representation of the ID into the decrypted content.

17. The method of claim 1 wherein the loaded content is encrypted, and wherein the imprinting step comprises simultaneously decrypting the content and imprinting a representation of the ID into the content.

18. The method of claim 1 further comprising enabling use of the digital content at the information terminal after imprinting the ID information.

19. A method for distributing a digital content comprising:

issuing a request for a digital content from an information terminal to a content manager, the request identifying the information terminal or a user thereof;

receiving a requested content transmitted by the content manager in response to the request, the received content being encrypted;

receiving a decryption program transmitted by the content manager in response to the request, the decryption program embedding ID information identifying the information terminal or the user thereof; and

processing the content using the received decryption program to produce a decrypted content having the ID information imprinted therein.

20. The method of claim 19 wherein the processing step comprises:

decrypting the received content using the received decryption program; and

imprinting the ID information into the decrypted content using the received decryption program.

21. The method of claim 19, further comprising protecting the decrypted content from being used prior to imprinting the ID information into the decrypted content.

22. The method of claim 19 further comprising enabling use of the digital content at the information terminal after imprinting the ID information.

23. The method of claim 19 wherein the information terminal and the content manager are connected to a network, and wherein the request, the digital content and the decryption program are transmitted over the network.

24. A method for distributing a digital content comprising:

receiving a request for a digital content at a content manager from an information terminal, the request identifying the information terminal or a user thereof;

transmitting a requested content to the information terminal in response to the request, the transmitted content being encrypted; and

transmitting a decryption program to the information terminal in response to the request, the decryption program embedding ID information identifying the requesting information terminal or the user thereof, the decryption program being operable on the transmitted encrypted content for producing a decrypted content having the ID information imprinted therein.

25. The method of claim 24 wherein the information terminal and the content manager are connected to a network, and wherein the request, the digital content and the decryption program are transmitted over the network.

26. A method for reading an ID from a digital content imprinted with the ID using the method of claim 4, comprising:

extracting the least significant bits from the sequence of data values at the predetermined location of the imprinted content; and

obtaining the ID from the extracted bits.

27. A method for reading an ID from a digital content imprinted with the ID using the method of claim 5, comprising:

extracting the offsets from the sequence of data values at the predetermined location of the imprinted content; and

obtaining the ID from the extracted offsets.

28. A method for reading an ID from a digital content imprinted with the ID using the method of claim 10, comprising:

extracting the imprinted inverse-transformed ID from the imprinted content;

transforming the extracted ID into a frequency-domain representation of the ID via the orthogonal transform; and

obtaining the ID from the transformed frequency-domain representation.

29. A method for reading an ID from a digital content imprinted with the ID using the method of claim 12, comprising:

extracting the imprinted inverse-transformed ID from the least significant bits of the data values of the imprinted content;

transforming the extracted ID into a frequency-domain representation of the ID via the orthogonal transform; and

obtaining the ID from the transformed frequency-domain representation.

30. A method for reading an ID from a digital content imprinted with the ID using the method of claim 13, comprising:

extracting the imprinted inverse-transformed ID by extracting the offsets from the imprinted content;

transforming the extracted ID into a frequency-domain representation of the ID via the orthogonal transform; and

obtaining the ID from the transformed frequency-domain representation.

31. An apparatus for imprinting identification information (ID) in a digital content comprising:

a communication section for receiving an encrypted digital content and a decryption program embedding ID information, the decryption program operable to decrypt the encrypted content and to imprint the embedded ID information into the decrypted content; and

means for utilizing the received decryption program to produce from the received encrypted content a decrypted content having the ID information imprinted therein.

32. The apparatus of claim 31 further comprising a display controller for displaying the decrypted content having the ID information imprinted therein.

33. The apparatus of claim 32 further comprising means for protecting the decrypted contents from being displayed prior to being imprinted with the ID.

34. The apparatus of claim 31 further comprising a memory for storing the decrypted content having the ID information imprinted therein.

35. An apparatus for imprinting identification information (ID) in a digital content comprising:

a communication section for receiving a digital content; and

an ID imprinter for imprinting the ID into a perceivable portion of the received content.

36. The apparatus of claim 35, wherein the imprinter imprints the ID in a predetermined location of the content.

37. The apparatus of claim 35, wherein the ID is represented in a frequency domain, the frequency domain being associated with a content domain defined by the content.

38. The apparatus of claim 35 further comprising:

a display controller for displaying the content; and

means for protecting the content from being displayed prior to being imprinted with the ID.

39. The apparatus of claim 35 further comprising:

a protector for protecting the digital content from being utilized prior to being imprinted with the ID.

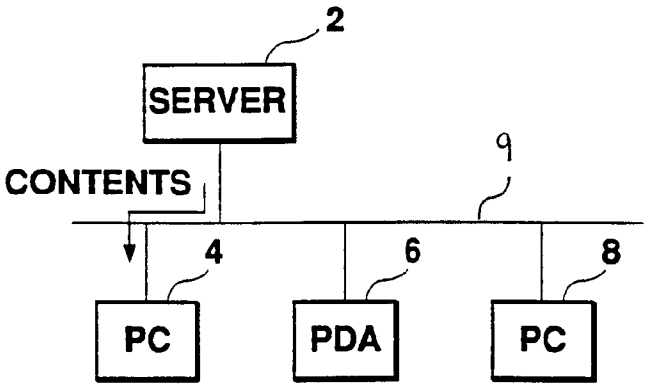

2
SERVER
CONTENTS
9
4
6
8
PC
PDA
PC

Fig. 1

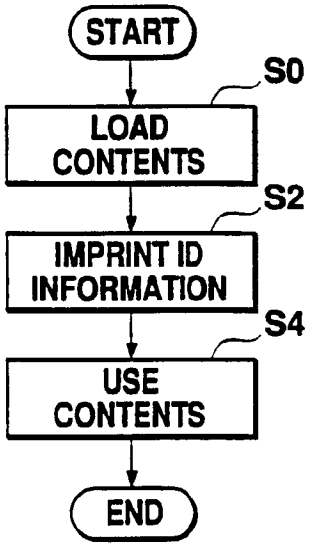

START
S0
LOAD CONTENTS
S2
IMPRINT ID INFORMATION
S4
USE CONTENTS
END

Fig. 2

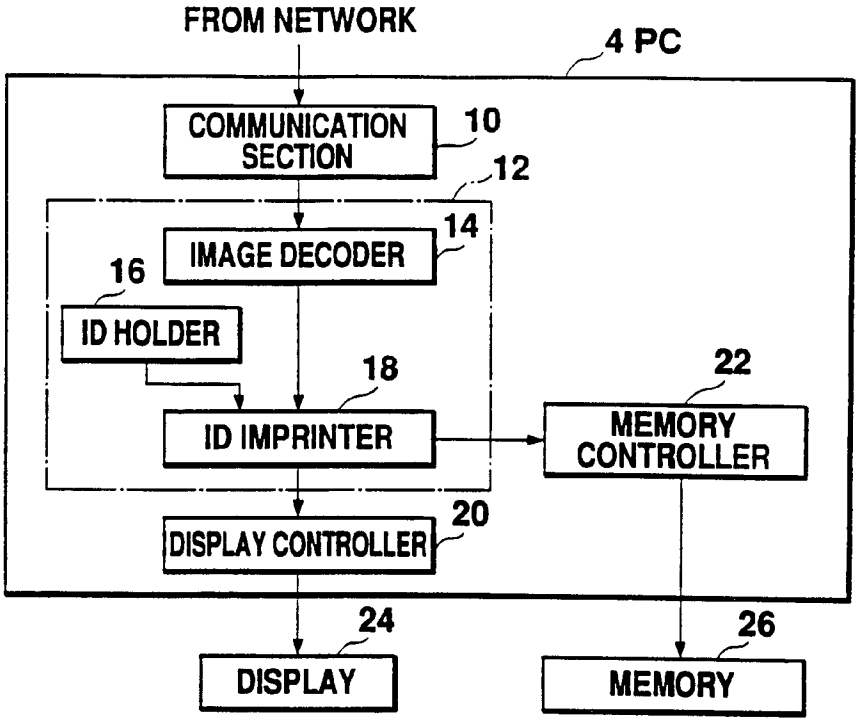

FROM NETWORK
4 PC
COMMUNICATION SECTION
10
12
IMAGE DECODER
14
16
ID HOLDER
18
ID IMPRINTER
22
MEMORY CONTROLLER
DISPLAY CONTROLLER
20
24
DISPLAY
26
MEMORY

Fig. 3

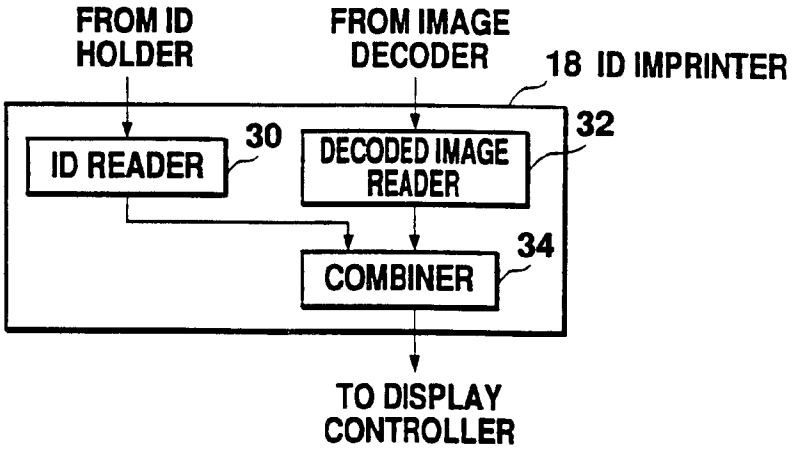

FROM ID HOLDER
FROM IMAGE DECODER
18 ID IMPRINTER
ID READER
30
DECODED IMAGE READER
32
COMBINER
34
TO DISPLAY CONTROLLER

Fig. 4

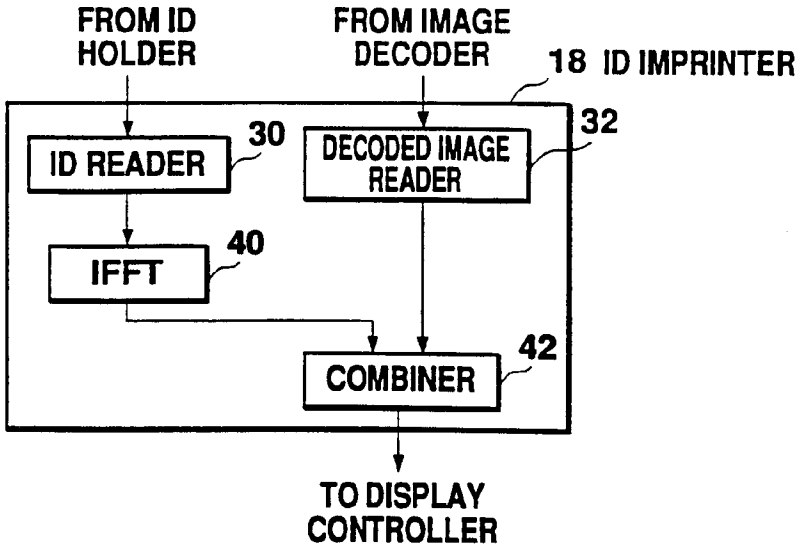

FROM ID HOLDER
FROM IMAGE DECODER
18 ID IMPRINTER
ID READER
30
DECODED IMAGE READER
32
IFFT
40
COMBINER
42
TO DISPLAY CONTROLLER

Fig. 5

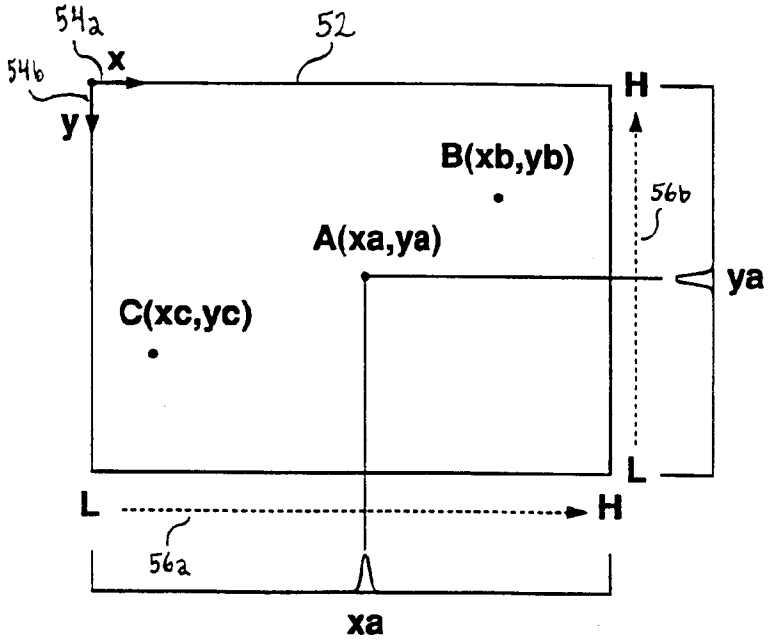

54a
52
54b
x
y
H
B(xb,yb)
56b
A(xa,ya)
ya
C(xc,yc)
L
L
H
56a
xa

Fig. 6

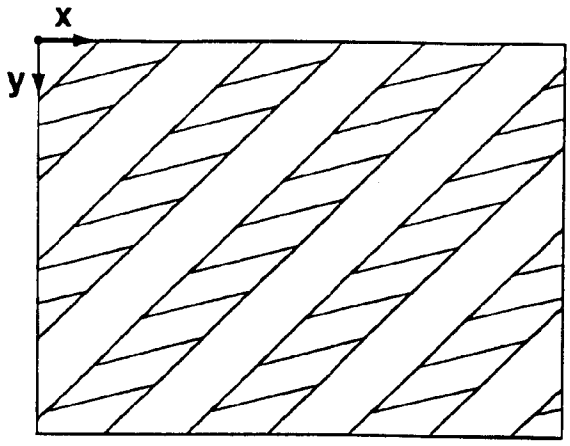


Fig. 7

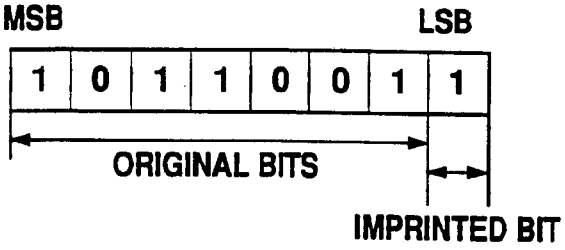


Fig. 8

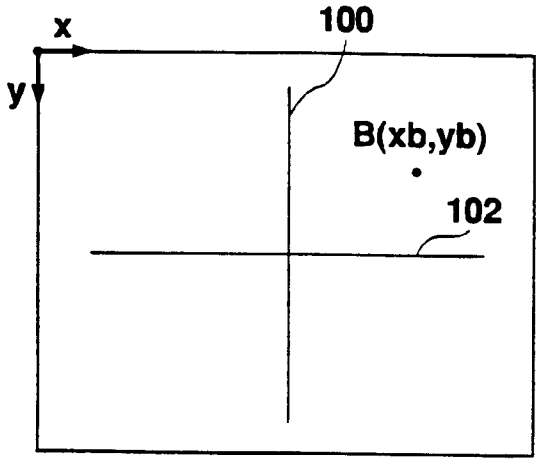


Fig. 9

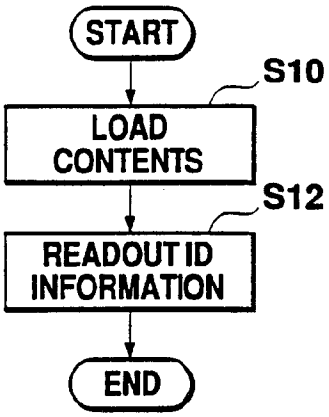

START
S10
LOAD CONTENTS
S12
READOUT ID INFORMATION
END

Fig. 10

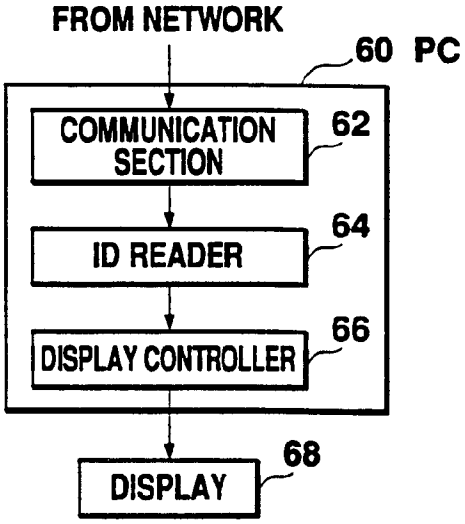

FROM NETWORK
60 PC
COMMUNICATION SECTION
62
ID READER
64
DISPLAY CONTROLLER
66
DISPLAY
68

Fig. 11

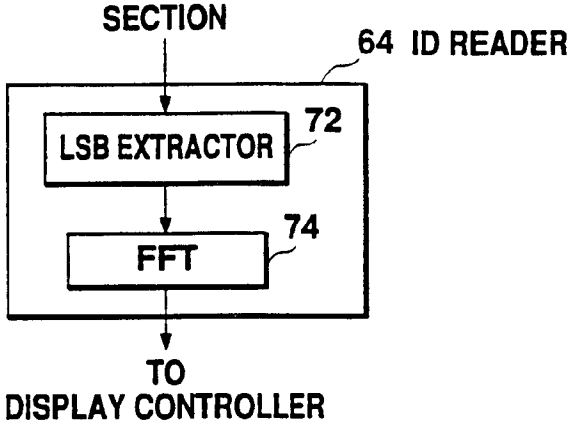


Fig. 12

10	8	0
20	30	7
16	12	100

Fig. 13

1	2	0
2	0	1
1	0	1

Fig. 14

0	0	0
1	1	1
2	2	2

Fig. 15

1-1	2+1	0+0
2-1	0+1	1+0
1+1	0-1	1+1

Fig. 16